Value Realization Pathways of Rural Ecological Products and Green Economic Growth Under the "Dual Carbon" Goals: A Rural Revitalization Perspective

Ajing Liu*
Wenshan Middle School, Changyi 261300, China
*Corresponding email: 15206705105@163.com

Abstract

The convergence of the "dual carbon" goals and the rural revitalization strategy has positioned rural ecological product value realization (EPVR) at a critical juncture linking ecological protection and green growth. Following the dual threads of ecosystem services and green growth theory, this article unpacks the four mechanisms of rural EPVR - accounting, conversion, trading, and feedback - and then traces the path of synergistic integration between industrial ecologization and ecological industrialization, with a parallel discussion of the role of ecological compensation. Several findings merit attention. EPVR drives green growth primarily through three channels - raising agricultural green total factor productivity, optimizing rural energy structures, and broadening farmers' income streams. The relationship between the dual carbon goals and rural revitalization is not zero-sum, but positive-sum. On the policy front, this article puts forward proposals across four directions - institutional gap-filling, market cultivation, technological reinforcement, and benefit-sharing mechanisms - among which the rationalization of carbon sink trading is perhaps the unavoidable threshold.

Keywords

Dual carbon goal, Rural ecological products, Value realization, Green economy, Rural revitalization

Introduction

Faced with the pressure of climate change, countries around the world are pivoting toward low-carbon trajectories. On China's side, the dual carbon goals are clearly defined - peak carbon emissions before 2030 and carbon neutrality before 2060; on the other side, rural revitalization demands that rural areas follow a path of ecological priority and green development. With both policy currents converging simultaneously, how can "lucid waters and lush mountains" be transformed into "invaluable assets"? How can ecological capital be converted into economic returns? This question, both theoretical and practical, is inescapable [1]. Tracing along this line may yield a clearer view of the intrinsic mechanisms underlying the green transformation of rural areas.

EPVR, at its core, is about internalizing the external benefits of ecosystems through market mechanisms to deliver reasonable economic returns to resource owners. It enables a self-sustaining cycle between conservation and development, and brings ecological and economic accounts into alignment as far as possible. Current research largely concentrates on refining accounting methods or discusses isolated case studies. Studies that place EPVR, green growth, and rural revitalization together within the overarching framework of the dual carbon goals are scarce [2].

This article primarily revolves around three key questions: What are the core detailed mechanisms and pathways of EPVR? How does it propel green growth forward? And where does the synergy between dual carbon goals and rural revitalization originate? Exploring these questions systematically can reveal the underlying logic of ecological value conversion. Following these threads, this article constructs a four-dimensional framework of "dual carbon-EPVR-green growth-rural revitalization," suggesting that the conversion potential of rural ecological resources is, in fact, far from negligible [3].

Literature review and theoretical framework

The theoretical basis of rural ecological product value realization

The term “ecological products” may be regarded as the localized Chinese expression of “ecosystem services”. A meta-analysis of existing data using meta-analytic techniques has found that the estimated values of different types of ecosystem services vary considerably. The choice of valuation method systematically biases the results. The divergence between the equivalent factor method and other approaches is particularly pronounced. Further research traces a chain of “accounting-conversion-trading-feedback”. Accounting to quantify value lays the foundation. Conversion through dual pathways to channel resources into industry is the centerpiece. Trading handles realization, and feedback ensures that returns flow back. A review of 321 publications offers a more definitive judgment: EPVR, by cultivating ecological industries, injects new growth momentum into rural revitalization, with the two mutually supporting each other’s ascent. This is currently one of the most important theoretical findings in the field. At the practical level, of course, context-sensitive policy design remains the key [4].

The coupling logic of green economic growth and the dual carbon goals

Green total factor productivity (GTFP), by incorporating carbon emissions and pollution as undesirable outputs, has become the benchmark for measuring green growth. Agricultural carbon emissions have been measured from five sources: agricultural inputs, rice cultivation, soil management, livestock, and crop residues. It was found that China’s agricultural GTFP grew at an average annual rate of 3.3%, with technological progress leading the way, yet technical efficiency actually declining. The regional disparities between eastern, central, and western China were strikingly large. Research employing a three-stage SBM-DEA model that incorporates both non-point source pollution and CO_2 as undesirable outputs has concluded that conventional measurements overestimate agricultural efficiency. The environmental cost dimension must be fully internalized. Simulations further indicate that rural carbon emissions could be compressed from 803 million tons in 2016 to near zero by 2060, with carbon sinks absorbing the entirety by 2050. This figure tells a story: the dual carbon goals are not sandbags tied to rural legs, but a window of opportunity forcing the green transformation of industries [5].

The role of payments for ecosystem services in rural green development

Payment for ecosystem services (PES) is an inescapable component of EPVR. Evidence indicates that the Grain for Green program significantly raised the incomes of middle- and high-income households, while ecological forest ranger positions provided more tangible support for low-income households. The effect of public welfare forest compensation, however, was barely discernible. The precision of targeting directly determines the effectiveness of outcomes. Furthermore, while the Grain for Green program did raise incomes, it simultaneously widened inequality, earning it the description of a “double-edged sword”. At the micro-level, EPVR alters farmer welfare across four dimensions - economic, social, environmental, and governance. Taken together, these findings sketch a reasonably clear outline of the inherent tension between ecological conservation and farmer income growth [6].

The analytical framework

The analytical framework can be summarized as follows: Externally, the dual carbon goals serve as hard constraints, and rural revitalization provides the strategic direction. At the core lies rural EPVR, whose four mechanisms—accounting, conversion, trading, and feedback—interlock in rotation. This framework then exerts force along three directions: raising GTFP, shifting the energy structure toward low carbon, and diversifying farmer incomes. The terminal output is green growth in which ecology and economy are synergistically aligned [7].

Pathway analysis of rural ecological product value realization

Core mechanisms: Accounting - conversion - trading - feedback

Accounting - this step is the prerequisite. The results produced by different methods are far apart. The real difficulty lies in the fact that ecological products inherently carry public goods attributes, with strong externalities rendering market price signals either absent or distorted. Conversion - this step is the pivot. On one side is industrial ecologization, pressing down the consumption intensity of traditional agriculture; on the other side is ecological industrialization, pushing forward new business forms. The two legs must move together for the path to be viable. Trading - this step is the carrier of market mechanisms, where environmental rights such as carbon emission allowances must be tradable, and direct monetization through brand premiums cannot be neglected either. Under the banner of dual carbon, the channel through which rural areas participate in carbon markets via carbon sink projects is gradually opening. Feedback - this step ensures long-term effectiveness. The revenues generated must be reinvested into ecological protection. Yet closing this loop requires that property rights be clearly delineated, benefits fairly distributed, and supervision effectively enforced - none of which can be circumvented. Without some hard measures on long-term incentive mechanisms, the follow-through will be difficult [8].

Improving payments for ecosystem services pathways

A “one-size-fits-all” compensation approach is vastly inferior to targeted, differentiated schemes in terms of poverty reduction. Compensation can raise incomes but may simultaneously nudge economic stratification in the same direction. To repair this mechanism, efforts must be exerted concurrently from three directions. Compensation standards cannot be measured with a single yardstick but must be tied to trends in ecological service values, regional economic levels, and farmers’ livelihood costs. Compensation modalities cannot be confined to cash transfers alone - technical training, industrial support, and employment placement must be woven together. As for the accounting system, without a clear picture of the baseline, even the best-designed compensation standards remain castles in the air [9].

Industrial integration pathways

The hard constraints set by the dual carbon goals are forcing the rural industrial structure to pivot toward low carbon. Industrial integration is probably the most effective pathway at present. Four directions merit attention. Agriculture paired with eco-tourism develops leisure sightseeing and health-oriented retreats. Agriculture bundled with new energy promotes agrivoltaic complementarity and biomass energy. Agriculture embedded in the carbon sink industry accumulates carbon sinks through afforestation, wetland restoration, and conservation tillage. These carbon sinks can then be monetized through carbon markets. Agriculture empowered by the digital economy - with big data, the Internet of Things, and blockchain in place - makes the provenance of ecological products traceable. And brand value rises accordingly [10].

Driving mechanisms of green economic growth under the dual carbon goals

Agricultural green total factor productivity improvement

Measurements are unambiguous: After stripping out environmental factors, agricultural GTFP is rising overall, but the interregional disparities are alarmingly large. Technological progress contributes the most robust component, yet the “last mile” of technical efficiency still falls short. The broad thrust of the subsequent push is as follows: green technologies - precision fertilization, water-saving irrigation, and the like - must be rolled out more broadly. Appropriately scaled operations help smallholders surmount the adoption threshold. Carbon emission reductions and pollution abatement should also be written into the ledgers of agricultural subsidies and performance evaluation [11].

Low-carbon transformation of rural energy structure

Simulations have already put up signposts - rural carbon emissions can be compressed from 803 million tons in 2016 to near zero by 2060, absorbed entirely by carbon sinks by 2050. Three conditions underpin this trajectory: clean energy scaling up, building energy efficiency spreading, and carbon sink capacity maximized. EPVR plays a critical role here - carbon sink trading provides a funding channel capable of sustainably supporting the promotion of rural clean energy and building energy retrofits. In other words, the proceeds from selling ecological products, in turn, propel the green transition forward. This closed loop is now complete [12].

Diversified income growth for farmers

EPVR opens four paths for farmer income growth. Direct compensation includes ecological compensation payments, Grain for Green subsidies, and dividends from carbon sink trading, all of which are cash in hand. Industrial operations include brand premiums on ecological agricultural products, revenues from rural tourism and guesthouses, and income from forest-based health and wellness. Asset appreciation includes returns from the transfer of land management rights, shares of profits from ecological resource equity participation, and the parallel rise in intangible brand assets. Labor employment includes public welfare posts in ecological stewardship, employment in green industrial parks, and green technology service positions. Pieced together, a comprehensive picture emerges of EPVR sustaining continuous income growth for farmers.

Policy recommendations

First, solidify the institutional foundations. The registration and confirmation of rights over rural ecological products must be advanced, with the boundaries of ownership, use rights, and income rights articulated in legal terms. Nationally unified accounting standards and technical guidelines can no longer be deferred. The contradiction of divergent methodologies and mutually incompatible results across regions is already acute enough. Laws and regulations on ecological compensation must also catch up, with compensation standard adjustment mechanisms and stable, long-term funding sources grounded in a statutory basis.

Second, thicken the market layers. The extension of the national carbon market into agriculture and rural areas can no longer wait. Access standards, verification methodologies, and trading rules for agricultural carbon sinks and forestry carbon sinks must be established as soon as possible. Regional ecological product trading platforms must also be built up to drive down information search and transaction costs, so that market liquidity and price discovery functions can rise. New financial instruments such as green bonds and ecological asset securitization should be promoted where appropriate, with the financial services underpinning EPVR keeping pace.

Third, let technology exert force from the rear. Investment in the research, development, and dissemination of green technologies - precision agriculture, smart agriculture, waste recycling - should be increased where warranted. Digital tools such as blockchain traceability and IoT monitoring should be deployed to build full-lifecycle traceability systems for ecological products, narrowing the information asymmetry gap wherever possible. Big data platforms for ecological product value accounting and dynamic monitoring must be established in a coordinated manner. Both policy and markets need data to speak on.

Fourth, sort out how benefits are shared. The “leading enterprise + specialized cooperative + farmer” model, combining contract purchasing, guaranteed minimum dividends, and equity-based cooperation, is needed. This ensures that farmers receive a defensible share in the distribution of value along the industrial chain. A dedicated EPVR fund should also be established, with a certain proportion of trading revenues institutionalized for reinvestment into community public services and ecological stewardship. Farmers’ rights to information, participation, and supervision cannot remain merely rhetoric; a viable participatory monitoring mechanism must therefore be established.

Conclusion

This article has traced the intrinsic linkages between rural EPVR and green economic growth under the dual carbon framework. Several things are now reasonably clear. EPVR is a closed loop in which accounting, conversion, trading, and feedback are interlocked. Only when the two legs of industrial ecologization and ecological industrialization move together can the value of ecological products be realized. EPVR drives green growth along three lines - GTFP rising, energy structure moving toward low carbon, and farmer incomes diversifying. Its relationship with the dual carbon goals is not a seesaw, but more like interlocking gears turning in the same direction. The cognitive misconception that conservation and development are a zero-sum game of “you gain more, I get less” should be put to rest. The dual carbon goals and rural revitalization are not antagonistic either: rural carbon emissions, offset by carbon sinks, can be leveled out around 2050, and the path of green development is viable.

Of course, the shortcomings of this article are plain to see - it lacks rigorous empirical testing with micro-level data, and the differences across various types of rural areas remain unexplored. Future work could pursue several directions: construct panel spatial econometric models to rigorously verify the causal chain and spatial spillover effects between EPVR and green growth; produce regionally differentiated policy prescriptions; and scrutinize the impact of carbon sink trading on farmer income and welfare using microeconometric tools, thereby providing forward-looking policy simulations for the extension of the national carbon market into rural areas.

Funding

This work was not supported by any funds.

Acknowledgements

The author would like to show sincere thanks to those techniques who have contributed to this research.

Conflicts of Interest

The author declares no conflict of interest.

References

[1] Kong, X., Su, L., Wang, H., Qiu, H. (2022) Agricultural carbon footprint and food security: an assessment of multiple carbon mitigation strategies in China. *China Agricultural Economic Review*, 14(4), 686-708.

[2] Guo, X., Yu, B., Yan, M., Guo, H., Ren, J., Zhang, H., Zhang, Z. (2022) Endogenous development models and paths selection of rural revitalization from the perspective of ecological environment advantages: A case study of Nanshi village, China. *International Journal of Environmental Research and Public Health*, 19(19), 11979.

[3] Xu, Y., Zhao, W., Zhang, Z. (2023) The practice of nature-based solutions in China: Ecosystem product value realization. *Current Opinion in Environmental Science & Health*, 36, 100514.

[4] Sun, Y., Zhao, J., Qiao, Q., Lin, Z., Zhang, W. (2024) Unlocking the Value of Nature: A Deep Dive into China's Ecological Product Realization and Its Driving Mechanisms. *Forests*, 16(1), 37.

[5] Zhong, S., Li, Y., Li, J., Yang, H. (2021) Measurement of total factor productivity of green agriculture in China: Analysis of the regional differences based on China. *PLoS One*, 16(9), e0257239.

[6] Wu, X., Liu, J., Fu, B., Wang, S., Wei, Y. (2021) Integrating multiple influencing factors in evaluating the socioeconomic effects of payments for ecosystem services. *Ecosystem Services*, 51, 101348.

[7] Liu, D., Zhu, X., Wang, Y. (2021) China's agricultural green total factor productivity based on carbon emission: an analysis of evolution trend and influencing factors. *Journal of Cleaner Production*, 278, 123692.

[8] Xie, X., Chen, S., Zhao, R. (2023) A preliminary evaluation of the effectiveness of ecological product value realization in China based on the DPSIR model. *Sustainability*, 15(21), 15572.

[9] Hou, L., Xia, F., Chen, Q., Huang, J., He, Y., Rose, N., Rozelle, S. (2021) Grassland ecological compensation policy in China improves grassland quality and increases herders' income. *Nature Communications*, 12(1), 4683.

[10] Fan, W., Huang, L., Tan, Z., Xue, F., De, G., Song, X., Cong, B. (2021) Multi-objective optimal model of rural multi-energy complementary system with biogas cogeneration and electric vehicle considering carbon emission and satisfaction. *Sustainable Cities and Society*, 74, 103225.

[11] Yu, Z., Lin, Q., Huang, C. (2022) Re-measurement of agriculture green total factor productivity in China from a carbon sink perspective. *Agriculture*, 12(12), 2025.

[12] Wang, X., Zhang, J. (2022) Basic path and system construction of agricultural green and low-carbon development with respect to the strategic target of carbon peak and carbon neutrality. *Chinese Journal of Eco-Agriculture*, 30(4), 516-526.